Space Weather Technical Forecast

Issued on Sunday, 27 November 2022 at 01:15 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Slight Chance of Minor Geomagnetic Storm (G1) intervals through the period. Chance of Active electron fluence from day 2 (28th).

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Very Low in the past 24 hours, with occasional upper level B-class flares. There are currently five sunspots on the Earth-facing disk, all of which are small, simple and apparently stable. Three regions are transiting toward the western limb, with the other regions located in the northeast quadrant. No new Earth-directed CMEs have been observed in available imagery.

Solar Wind / Geomagnetic Activity: Solar wind parametres, as measured by ACE and DSCOVR at L1, were indicative of positive coronal hole HSS influences. Solar wind speeds have risen from 450-530 km/s to 550-630 km/s. Density was around average or a little above, with a peak of 14 ppcc at 26/1955 UTC. The interplanetary magnetic field, IMF Bt, rose from weak to moderate, peaking at 11nT at 26/1300 UTC, before becoming weak again. The north south component remained weak, fluctuating between +7/-7nT. The phi angle was mostly positive (away from the Sun). Geomagnetic activity was largely Unsettled (Kp 3), but with a single Active (Kp 4) spell during the first period.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10MeV) as measured at GOES16 has remained at Background levels.

High energy electron flux (greater than 2MeV) at GOES16 was at Background to Moderate levels. Electron fluence levels has been on a continued rising trend but has remained well below the Active (1e8 integrated pfu) level. Observed fluence at 27/0000 UTC was 4.7e6 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is expected to remain Low or Very Low, with a chance of isolated C-class flares and a very slight chance of isolated M-class flares.

Solar Wind / Geomagnetic Activity: The CME eruption on 24th Nov may give a glancing blow at Earth between days 1-3 (27th-29th). Earth is now in the HSS of CH48/+, with the peak speed likely to have already been experienced and now on a gradual slight decline. The next coronal hole enhancement will likely be from CH49/+, which is a recurrent feature. This is expected at Earth from day 3 (29th), with elevated winds speeds most probable.

Geomagnetic activity is expected to be mainly Unsettled to Active, with a slight chance of G1/Minor storm intervals each day due to either CME or coronal hole HSS effects, should they materialise.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10MeV) observed by GOES16 is expected to remain at Background levels throughout.

The high energy Electron flux (greater than 2MeV) at GEO, may begin to reach High levels

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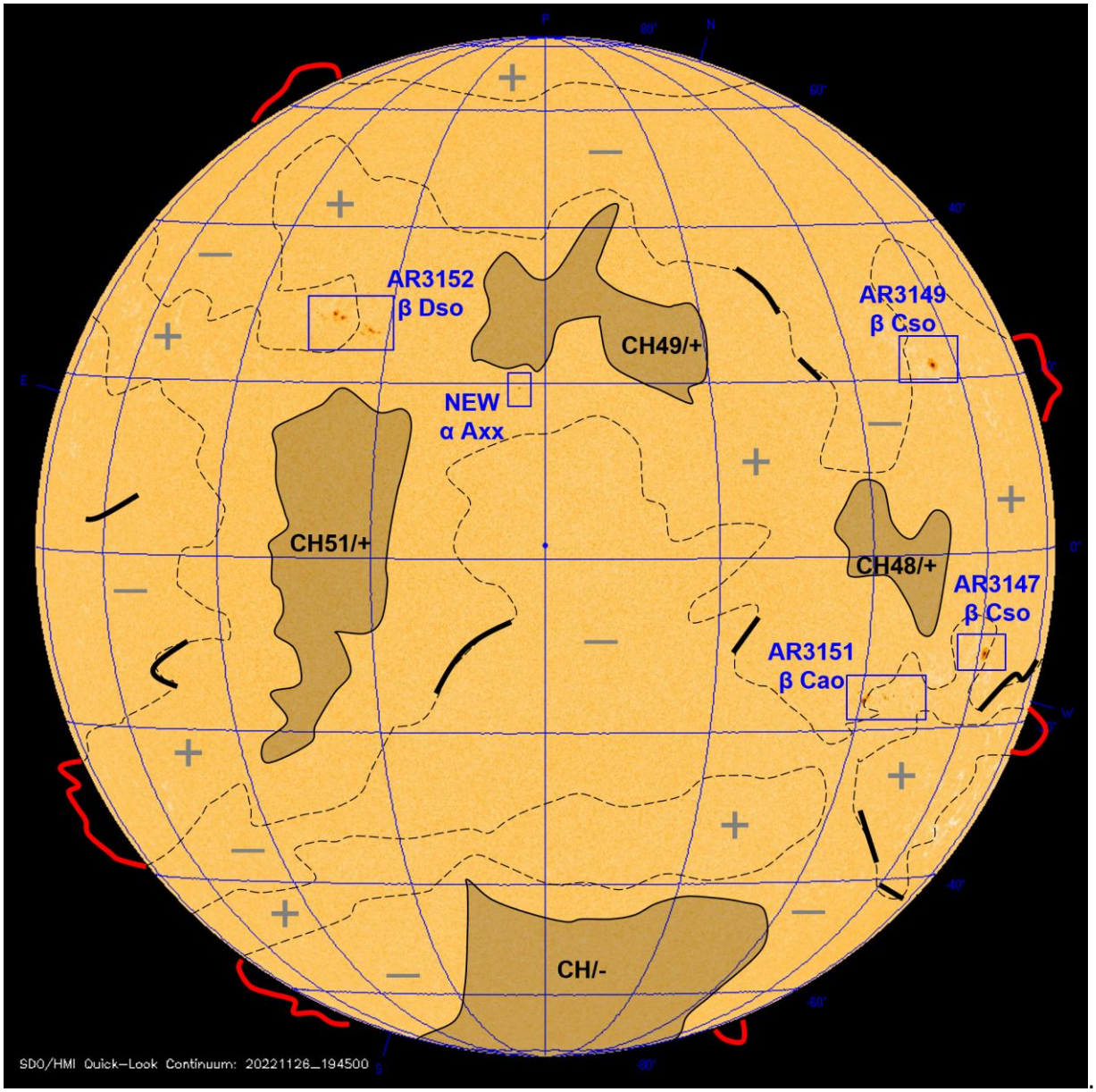
during the diurnal maxima on each day, although the possibility of a passing of a CME introduces greater than average uncertainty on this trend. The associated 24-hour integrated fluence is expected to remain below Active (1e8 integrated pfu) throughout, but with a chance from day 2 (28th) onward of rising above.

Figure 1. Solar Analysis Valid 26/2000 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

Several recent CMEs have occurred on, or close to the Earth-Sun line. There is greater than average uncertainty regarding the timings and impacts of these features however, given intermittent solar imagery and faint coronagraph signatures to fit analysis. On 24 Nov a two-stage filament eruption was observed from a region near the centre disc in the southern hemisphere. These both resulted in a faint CME signature on coronagraph imagery, however, analysis of the CME(s) was very difficult, with significant imagery gaps compounding the faint CME trace. An Earth-directed component is expected, however, confidence in timings and effects are low and the CME could arrive anywhere between the 27-29 Nov.

Earth is now assessed to currently be in the HSS of CH48/+ with the peak speed expected to have already been experienced and now on a gradual slight decline. CH49/+ in the northern hemisphere is a recurrent feature, which is expected at Earth from 29 Nov, with speeds more typically around 450-500km/s.

Geomagnetic activity is expected to be mainly Unsettled to Active, with a slight chance of G1/Minor storm intervals each day due to either CME or coronal hole HSS effects, should they materialise.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	25	20	20	10
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
25/1904	Parital	Filament	S Hemisphere (Centre Disk)	630 km/s	Any time between 27/1200-29/0001	Low confidence in timings

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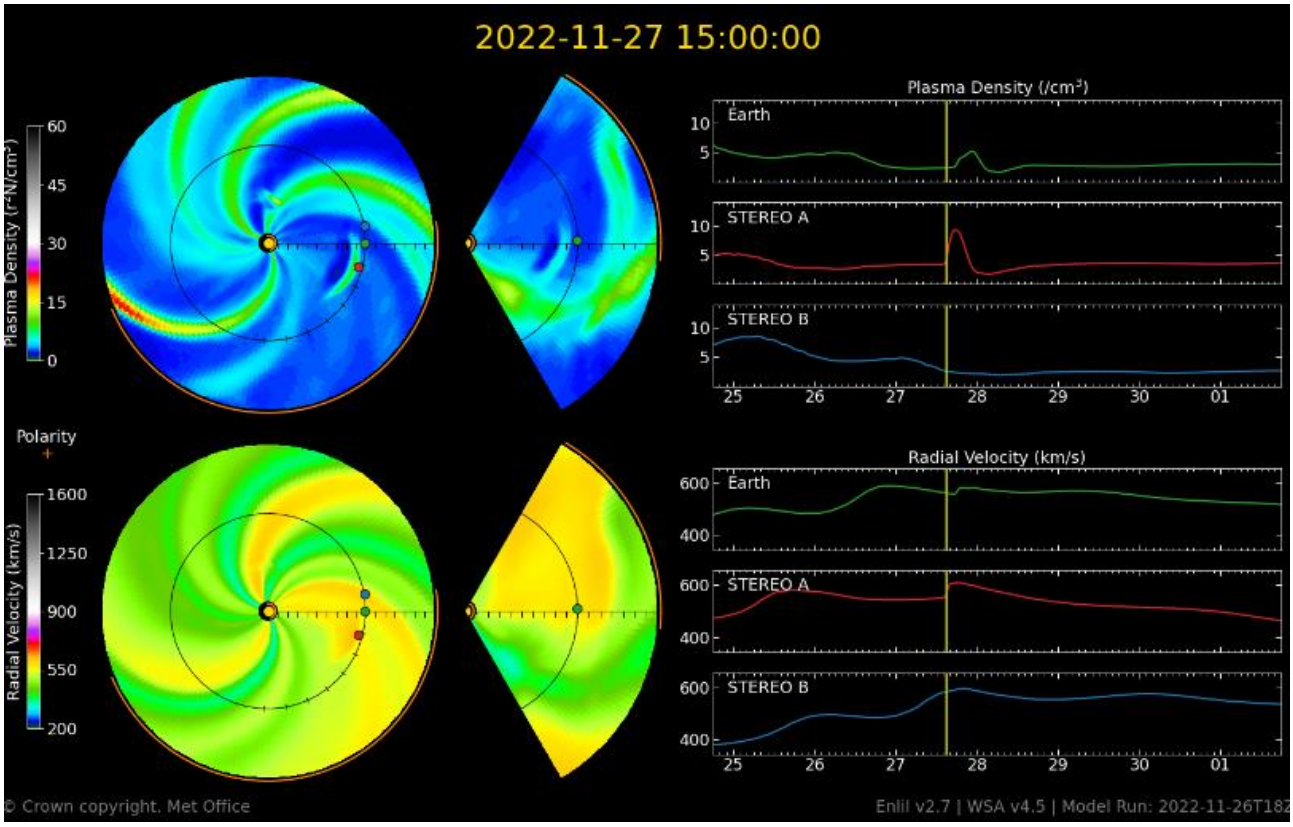
Figure 2: MOSWOC ENLIL sowing possible solution for arrival of CME from 25th



Radio Blackouts - X-Ray Flares:

Solar activity is forecast to remain Low or Very Low over the four-day period with all of the current four numbered Earth-facing sunspots small, simple and apparently stable. Three of the regions are transiting toward the western limb, with the other region located in the northeast quadrant.

Meanwhile, on the eastern horizon, the Carrington locations for several far sided regions should arrive at the eastern limb from 28 Nov (Day 3). This results in an overall level trend through the four days as none of the upcoming sunspot groups has shown inferred significant flare or CME activity from coronagraph imagery.

Overall there is a chance of further isolated C-class flares, with a very slight chance of isolated M-class flares.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	5	5	5	5
Very Active	R3 to R5 X Class	No	1	1	1	1

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Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10MeV) at GEO, as observed by GOES16 is currently at background levels and is expected to remain at this level throughout.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ S1	No	1	1	1	1
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

High energy electron flux (greater than 2 MeV) observed by GOES16 has recently risen from normal background levels to moderate levels in the past 12 hours. In coming days, flux levels may begin to reach High levels during the diurnal maxima. The upward trend will likely continue through the period, although the possible CME arrival between 27th-29th may have the impact of knocking out some electrons within the electron field and curb the expected rise.

The quieter conditions that should greet the forthcoming new UTC working week should allow the Van Allen belts to equilibrate, and offers the greatest likelihood of exceeding Active 24-hour integrated fluence. This suggestion is based on recurrence from the previous rotation, where Active fluence was observed, though confidence is rather low given additional complications owing to one or more CMEs expected during the period.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ 2 MeV ≥ $1x10^8$	No	10	30	40	40
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

Figure 3: MOSWOC REFM integrated flux/fluence.

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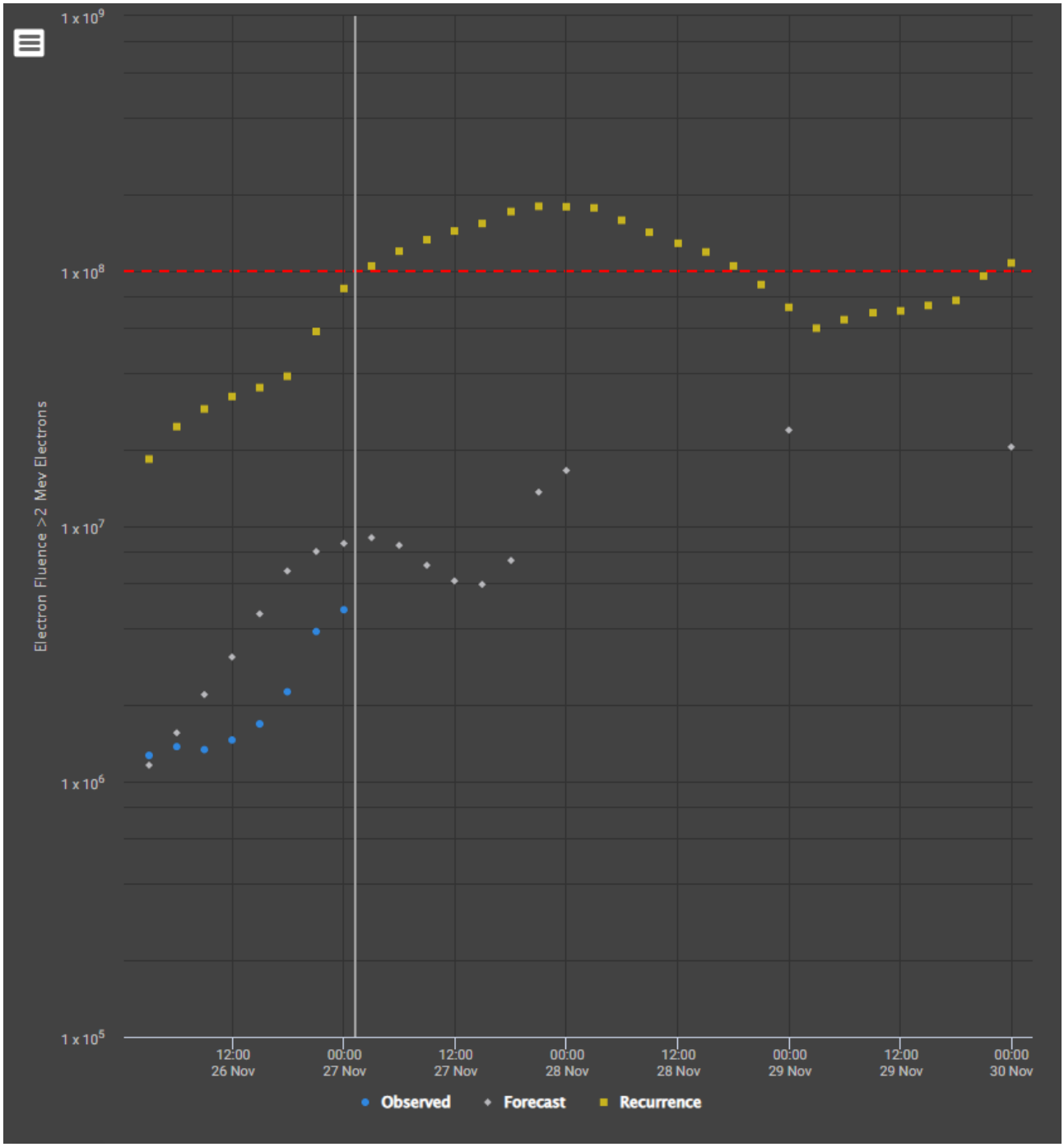

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